AN UNUSUAL MIOCENE PELECYPOD BURROW

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During recent field work in southern Florida the authors collected a large number of macroscopic invertebrates, predominantly *Balanus* and *Ostrea*, from a State Road Department borrow pit near Nocatee, De Soto County. The fossiliferous deposits at this pit represent an arenaceous facies of the Tamiami formation of late Miocene age. What was at first considered an unusual cluster of barnacles proved, upon preparation, to be the burrow linings of a boring pelecypod. No attempt is here made to assign this fossil to genus in the absence of shells. Microscopic examination of the external surface of the calcitic burrow linings indicates that the molluscs probably bored into a dense colony of a tubiculous annelid (*Serpula*), which has since been leached and eroded away (see fig. 1, top).

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Occurrence

The specimen was collected from a State Road Department borrow pit (N. E. ¼ S. E. ¼ Sec. 24, T. 38 S., R. 24 E., Arcadia Quadrangle) along Florida Highway 760, approximately 1.6 miles east of the junction of U. S. Highway 17 and Florida Highway 760 at Nocatee, De Soto County, Florida.

Sediment samples from the fossil bearing horizon in the quarry consist of light gray to greenish-gray calcareous and argillaceous sand. The quartz particles are poorly sorted, angular, and range in size from coarse to very fine, with fine size particles predominating. Insoluble residues of a 50 gm. sample digested in 20 per cent hydrochloric acid for 24 hours amounted to 70.8 per cent of the sample, of which 37.6 per cent had a particle size of less than 62 microns. Round, smooth, brownish-black phosphate grains constitute only a minor fraction of the sediment.

The areal extent and stratigraphy of the deposits from which the cluster of burrows was collected have been discussed by Berg-

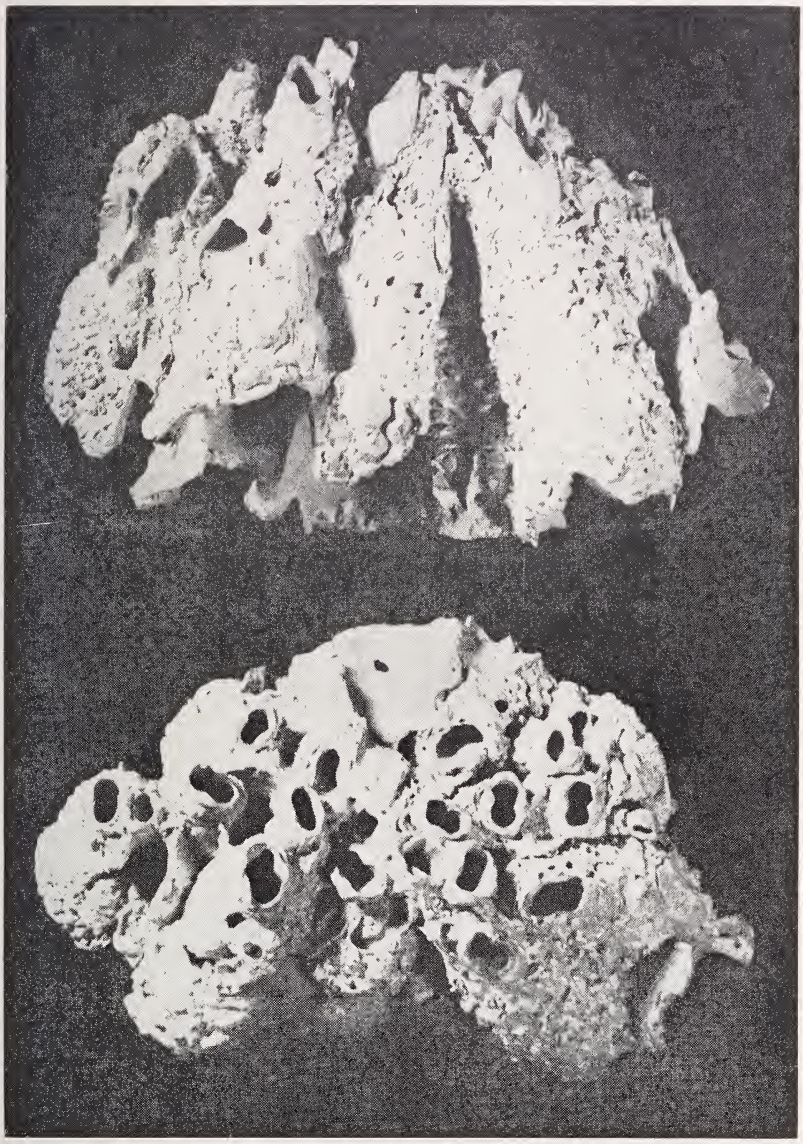

Fig. 1. Lateral (top) and siphonal (bottom) views of the pelecypod burrow linings. Hypotype, Florida State Museum No. 1318. Actual width of specimen, 11 cm.

endahl (1956). The Arcadia marl, described by Dall (1892), is a light colored, phosphatic, calcareous sand outcropping about 6 miles north of Arcadia, De Soto County, and was considered, by Dall, to be of early Pliocene age. Dall also reported exposures of an oyster marl along the Peace River at Shell Point, approximately 3 miles north of Arcadia. Similar outcrops were reported from the vicinity of Nocatee and Zolfo Springs. Bergendahl dated the Arcadia and "oyster" marls of Dall as being of late Miocene age. These fossiliferous sands and marls overlie the middle Miocene Hawthorn formation, and are here considered a lithofacies of the Tamiami formation which, as defined by Parker (1951), includes all of the upper Miocene strata in southern Florida. Specimens of *Ecphora quadricostata umbilicata* (Wagner) in the Florida State Museum collections at the University of Florida from near Fort Myers and from near Buckingham in Lee County serve to confirm the upper Miocene dating of the Tamiami formation proposed by Parker.

Bergendahl stated that these deposits are indicative of a shallow marine environment. The foraminiferal assemblage, identified from these deposits by the authors (*Anomalina io, Bolivina* cf. *B. advena, Bulimina* cf. *B. elongata, Cibicidella* cf. *C. variabilis, Discorbis* cf. *D. consobrina, Discorbis* cf. *D. vilardeboana, Lagena clavata, Nonionina* cf. *N. depressula, Textularia candeiana,* and *T. gramen*), however, indicates a bathymetric range of approximately 15 to 20 fathoms or less. The presence of *Balanus* and *Ostrea* cannot be considered discordant because this depth range is well within the maximum for these genera. The comminuted barnacle-oyster marl at Nocatee suggests a deep epineritic shelf environment with moderate to strong turbulence. The environmental conditions, based upon the foraminiferal assemblage, do not indicate "shallow" water as postulated by Bergendahl.

Morphology

The external surface of the fossil burrow linings, as preserved, consists of impressions of closely packed worm tubules and of barnacle shells which were incorporated into the mass of worm tubules as the *Serpula* colony grew. The fossil clams lined their siphonal canals and the posterior portion of the burrows with successive layers of calcareous material, evidence for which may be seen where pieces of the canal openings have been broken away.

The linings are probably secreted by the walls of the siphon and the mantle (Yonge, 1955).

Only the morphological features of the posterior portion of the living chambers are preserved, the anterior portion being broken and leached away, with one exception. A young, second generation individual subsequently bored along the side of the pre-existing chambers. From this individual it can be seen that the living chamber was elongate-expanding and flagon-shaped, whereas the remaining incomplete burrows are funicular in shape. The internal surface of the shell chamber is smooth and circular to subcircular in cross section. The siphonal canals are moderately short and somewhat constricted in the middle, suggesting a figure 8 in cross section (see fig. 1, bottom).

The numerous borings are closely packed together and are separated only by thin walls. Because of this proximity, the siphonal canal openings are not directly above the shell chamber. The external openings are appreciably narrower than the living chamber itself, the size of which is adjusted to the growth of the animal, so that the burrowers are confined to this elongate-expanding domicile for life.

Measurements of a representative mature individual are as follows: diameter of shell chamber, 22.5 x 22.0 mm.; length of shell chamber, 45.2 mm.; length of siphonal canal, 29.1 mm.; diameter of siphonal opening, 2.9 x 5.6 mm.

Remarks

Representatives of the genera *Gastrochaena, Spengleria,* and *Rocellaria* of the family Gastrochaenidae, *Pholas, Barnea, Martesia, Diplothyra,* and *Pholadidea* of the family Pholadidae, *Petricola* and *Rupellaria* of the family Petricolidae and *Botula* and *Lithophaga* of the family Mytilidae, as well as many other genera, are known to burrow in shells, wood, coral, or unconsolidated and lithifield sediments. There is an extensive literature dealing with the mode of burrow excavation in these groups (Turner, 1954). Few studies, however, have been directed toward the morphology of this type of mollusc burrow; thus generic identification of this fossil is not warranted.

The rate of growth of the clam, and the size and shape of the burrow, depend largely upon the hardness of the substratum and the amount of crowding. Furthermore, siphonal sinuosities are

also a function of crowding and type of substratum, and in the case of coralliophilic species a function of the coral's growth pattern. When all of these and many other variables are taken into account, a pattern will no doubt emerge which will permit recognition of suprageneric taxa based on distinctive characteristics of the burrows and burrow linings.

Yonge (1955) noted that the posterior portion of the burrows and the siphonal canals of several species are lined with calcareous material. However, not all of the above mentioned boring molluscs secrete such a lining (e.g., species of *Lithophaga* and *Barnea*). Also, it should be noted that the Mytilidae have poorly developed siphons. Therefore it is improbable that the fossil burrows reported here belong to a species of this family.

Gardner (1943) questionably assigned a burrowing mollusc from the Miocene Yorktown formation of Virginia to the genus *Coralliophaga* of the family Trapeziidae. A comparison of the present specimen with the illustrations given by Gardner (pl. 9, figs. 2 and 6) indicates that there is a great similarity. Although it cannot at this time be ascertained if different species are represented, neither specimen can be assigned to the genus *Coralliophaga*, as this mollusc lives in the burrows made by other boring clams.

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